

October 22, 1975

Attachment

(More specific information using Biting flies attacking Beef and Dairy Cattle as an example.)

III.1 New and Improved Methods to Reduce Losses caused by Insects, Ticks, and Mites.

III.1.1. Beef and Dairy cattle

III.1.1.1. Biting Flies

A. Current Technology

General Statement

1. Discuss most commonly used and the most advanced technology.
2. Discuss differences between most commonly used and most advanced technologies. Deterrents?
3. Discuss promising approaches based on field tests, pilot experiments, etc.
4. Discuss and justify need for basic research.
5. Discuss and list in tabular form the cost efficiency of currently used technology.
6. List advances made in last 10 years including those that are used in 1975, those are not used - why? - and backlog of technology and research which may produce commonly used control technology in the future.

B. Visualized Technology

General Statement

At current support level (\$ and SY's)

What can we develop that will be in commercial use by 1985 or sooner? Specific examples such as (1) reduce cost of controlling biting flies in feedlots by 50%; (2) develop effective insecticide for use on lactating dairy cattle.

Substantiate support of basic research.

Describe laboratory research that will move to field research.

Describe field research that will go commercial.

Quantify objectives

Example: (1) horn fly control costs and losses presently costs \$ ____/head of dairy/year--by developing a long residual insecticide costs and losses will be reduced ____%; (2) develop technology for fly control in dairies, specifically for lactating animals, where control technology is virtually non-existent in 1975. Specify type of control: insecticide, IGR's, physical control, genetic control, etc.

C. Research Approaches

General Statement

1. Describe specific research approaches to mesh with Visualized Technology - example: how would we proceed to develop the Visualized Technology for stable fly control in cattle feedlots?

Where is work being done (region, area, location)? Where should it be done? Specific procedures to develop dung beetle complex for dung removal to decrease fly breeding, decrease internal parasite contamination of cattle, and increase fertilization of soil. Where now? Where future?

D. Consequences of Visualized Technology

(Desirable and Undesirable)

1. Desirable consequences (generalized)

Cheaper food

Cheaper protein

Less pollution

Less complaints from campers and picnickers about stable fly bites

2. Undesirable consequences (generalized)

More insecticide usage

Increase camping which causes forest fires

Surplus of milk with drop in income to dairies

NOTE: This section is intended to be general and to indicate what else may happen.

E. Potential Benefits

This is the real place to indicate how much money can be saved by developing the Visualized Technology by 1985. All \$ figures must be referenced.

1. Example: If a parasite is to be developed that will control stable flies in feedlot conditions, (1) estimate current losses, (2) estimate current control costs; (3) estimate control costs with parasite; (4) estimate losses after parasite control technology introduced; (5) estimate cost of developing stable fly parasite control technology.
2. Example: Develop a tabanid repellent for beef cattle that is effective for 3 months.

NOTE: Potential benefits will be calculated only for specific items listed under Visualized Technology.

F. Research Effort

1. Current level

- (1) SY's and gross \$
- (2) Include where possible data on ARS, SAES, private industry, etc.

NOTE: This will be done in Beltsville--do not fiddle with it.

2. Expanded level

- (1) SY's and gross \$ needed to reach Visualized Technology by 1985. Include data on SY's, facilities (buildings, land, equipment, locations, etc.). Include estimate of how much faster the Visualized objectives can be reached with the expanded effort.

(2) Example: To develop non-insecticidal method of controlling stable flies in feedlots, utilizing parasites, manure removal and processing, and trapping.

<u>Organization</u>	<u>Current Support</u>			<u>Expanded Support for ARS</u>	
	<u>Yr.</u>	<u>SY's</u>	<u>Gross \$</u>	<u>SY's</u>	<u>Gross \$</u>
ARS	1976	2	95,000	6	500,000
SAES	1976	4	160,000	-	---
Others	1976	?	?	-	---
Total	-	6	255,000		

Years to achieve non-insecticidal method of stable fly control in feedlots:

With current support 10

With expanded support for ARS 5

CIRCULATE & RETURN
Jan 2

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
NATIONAL PROGRAM STAFF
Beltsville, Maryland 20705

RECEIVED NOV 3 1975

October 24, 1975

Subject: ARS National Research Programs

To: D. E. Weidhaas, Gainesville, Florida
H. C. Chapman, Lake Charles, Louisiana
B. M. Glancey, Gulfport, Mississippi
R. L. Harris, College Station, Texas
R. O. Drummond, Kerrville, Texas
✓ J. W. Snow, Mission, Texas
W. M. Rogoff, Fresno, California
N. O. Morgan, Beltsville, Maryland

As most of you know, ARS is preparing National Research Programs (NRP). There will be 67 of these documents covering all of the research that ARS is doing; in addition there will be several so-called special research projects covering pilot tests, minor use pesticides, etc.

One of these NRP's will be on insects affecting livestock and a second will be on insects affecting man.

When completed these documents will be utilized in essentially two ways:

1. To present a concise summary of all ARS activities to administrators, Office of Management and Budget, the layman, and possibly to Congress. Thus this part will be written in layman's terms.
2. To have available for the bench scientist a document outline of research in which he is involved. The intent is that each scientist will be able to locate him- or herself in the NRP and see where he fits in the overall program. This part of the document will be written in considerable detail, contain as much economic data as can be assembled, and will essentially do the following for each of our NRP's.
 - a. Described the current methods of controlling livestock and people insects.
 - b. Describe where we want to go during the next 10 years.
 - c. Describe the specific research approaches that we will undertake to arrive at where we want to be at the end of the 10-year period.

10

10

10

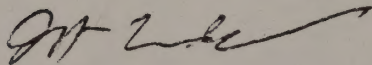
D. E. Weidhaas, H. C. Chapman, B. M. Glancey,
R. L. Harris, R. O. Drummond, J. W. Snow,
W. M. Rogoff, and N. O. Morgan

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- d. Describe what the results of getting there will be on overall agriculture.
- e. The potential benefits from such achievements.
- f. The amount of money and people required to do this.

The importance which the Administrator's office is placing on these documents should not be underestimated. The National Program Staff has been told that the preparation and completion of these documents is their top priority item. Travel is to be curtailed until they are completed or near completion. The deadline date for completion is February 1976; this is 3 months off. Unfortunately the NRP's for livestock insect control and insects affecting man are considerably behind most of the other NRP's. You and your staffs will be requested to make contributions to these documents; hopefully you will agree and do everything possible to assist me in preparing meaningful NRP's. Since this document will be the guidelines, both budgetwise and researchwise, for the next 10 years we should all attempt to do a good job.

I am asking the heads of each of the laboratories to keep the professionals in their laboratories informed of this NRP, perhaps by circulating this memo, so that when they individually receive a draft of these NRP's they will have some idea of what it is all about.



D. A. Lindquist
Staff Scientist
Insects Affecting Man and Animals

III Technological Objective

III.1 New and Improved Methods to Reduce Losses Caused by Insects, Ticks, and Mites

4. Screwworm

A. Current Technology

The sterile male technique has been a highly successful method for control of the screwworm fly with eradication of the pest being accomplished in the Southeastern United States as well as on the island of Puerto Rico. In the Southwestern United States, the technique has provided adequate protection for warm-blooded animals and man for the past 13 years. However, constant reinfestation from Mexico has allowed the screwworm to reinfest the United States each year. The concept of using the behavior of a pest to eliminate itself is one of the truly original ideas of the twentieth century and has been expressed in one of the most dramatic demonstrations of the value of science to civilization. No other entomological pest management program researched, developed, and executed by the U. S. Department of Agriculture has had the impact on the producer and consumer that the screwworm program has had!

However, during 1972, the program suffered a serious setback in that 96,625 cases were reported in Texas alone. There were undoubtedly more unreported cases. During this year, the United States signed an agreement with Mexico to extend the eradication

program to the Isthmus of Tehuantepec. During 1973 and 1974, the situation was again serious in South Texas. Some ranchers reported as much as 20% loss of herds. Effective control was not obtained until late season as a result of adverse weather. These outbreaks were related to high populations of the Gulf Coast Tick that provided large numbers of wounds. The number of cases for 1975 have already exceeded those for 1973 and 1974, and Gulf Coast Ticks have again been a problem. Therefore, the fact becomes apparent that the screwworm program has been extended to include Mexico at a time when results suggest that serious problems exist in our current program.

Potential causes of the reduced effectiveness are:

(1) Nutrition. The factory converted to a hydroponic diet shortly before the first outbreak in 1972. This diet has been used since that time. Sufficient data are not available to establish this medium as a good substitute for meat.

(2) Assortative Mating. The selection of an avoidance or recognition mechanism by wild flies over the last 12 years (resistance).

(3) Behavioral Isolation. Undetected changes in rearing and handling procedures that resulted in alteration of behavior sufficient to isolate the released population (preferential mating of factory x factory flies).

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Potential causes of the reduced effectiveness are:

(1) Insulation. The factory converted to a

hydroponic diet shortly before the first outbreak in 1972. This

diet has been used since that time. Sufficient data are not

available to establish this medium as a good substitute for meat.

(2) Associative Mating. The selection of an

avoidance or recognition mechanism by wild flies over the last 12

years (resistance).

(3) Behavioral Isolation. Undetected changes

in rearing and handling procedures that resulted in alteration of

behavior sufficient to isolate the released population (preference).

mating of factory x factory flies).

(4) Laboratory Adaptation of Strains. Factory strains may lose the ability to compete in the field through natural selection in the process of becoming adapted to factory production.

(5) Remating. Factory males may no longer be able to satisfy the wild females in copulation. Equally possible is the selection of wild fly populations that mate multiply.

(6) Ticks. Increased screwworm cases resulting from an increase in number of wounds caused by the Gulf Coast Tick.

(7) Quality Control. Inadequate control of quality in the rearing, packaging, or distribution phase that results in the release of non-competitive insects.

(8) Weather. Favorable weather which results in excessive survival of screwworm populations during the winter months.

(9) Changes in Practices. Ranchers have changed their practices with the result of more cattle, uncontrolled calving, absence of sufficient cowboys, etc.

B. Visualized Technology

With the 1972 outbreak, restaffing and funding has occurred at the Mission location. The primary objectives of this research can be viewed in 3 ways:

(1) An evaluation and identification of the factors involved in the recent reduced effectiveness of program-reared flies.

(4) Laboratory Adaptation of Strains. Factory

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B. Visualized Technology

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has occurred at the Mission location. The primary objectives of

this research can be viewed in 3 ways:

(1) An evaluation and identification of the

factors involved in the recent reduced effectiveness of program-

reared flies.

(2) The development of procedures or concepts that restore or improve overall program effectiveness.

(3) The investigation and study of the organism in the diverse terrain situation of Mexico and the integration of these findings into the action program.

C. Research Approaches

(1) Evaluation, identification, and solution of program problems.

(a) Monitor effectiveness of the APHIS Screwworm Eradication Program in the U. S. and Mexico. Ratios of wild to released flies will be determined with liver traps and sterility of egg masses determined.

(b) Evaluate the ~~quality~~ quality of flies produced on hydroponic and meat diets.

(c) Develop procedures to maintain quality of the factory flies. In this work, isoenzymes development rates as well as sensitivity to sound and sight will be used.

(d) Study behavior patterns of wild and factory flies. This research will be conducted to identify assortative mating or behavioral isolation, if it exists. Daily rhythms, response to temperature, photo period, etc., will be determined.

(2) Development of procedures or concepts.

(a) Develop new and improve the current trapping system. The development of a synthetic attractant will be

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to temperature, photo period, etc., will be determined.

(2) Development of procedures or concepts.

(a) Develop new and improve the current

trapping system. The development of a synthetic attractant will be

continued by screening chemicals commonly found in association with wounds. New trap designs and exposure systems will also be evaluated. Sex attraction will be studied for use in a trap.

(b) Find new sources of diet protein that offer price, supply, or biological advantages.

(c) Develop new and/or improve sterilization techniques. The current radiation dosage will be studied to determine if a reduction in dosage is possible. In addition, radiation in various gasses will be evaluated.

(d) Develop new colonies of flies for the Mexico and Texas program. Egg masses will be collected from geographic areas of Mexico and Texas and evaluated for inclusion in new strains.

(3) Investigate organism in Mexico.

(a) Study the ecology of the insect in Mexico and the U. S. The behavior of the fly in canyons and at different altitudes will be studied to determine release tactics and strain alterations necessary to insure insect performance.

(b) The possibility of biotypes in Mexico must receive considerable research because of physical isolation and terrain diversity. If it exists, procedures or strains must be developed for each situation.

(c) Determine the overall highest population and assist in the development of release tactics. This will be

continued by screening chemicals commonly found in association with wounds. New trap designs and exposure systems will also be evaluated.

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(c) Determine the overall highest population

and assist in the development of release tactics. This will be

determined by extensive trapping and observation in the various areas of Mexico. Research will continue to develop trapping systems capable of serving as an additional control procedure.

(d) Research unexpected or new problem areas as they develop.

D. Consequences of Visualized Technology.

To restore the program to earlier effectiveness and provide the new data necessary for a successful Mexico program.

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D. Consequences of Visualized Technology.

To restore the program to earlier effectiveness and provide the new data necessary for a successful Mexico program.

E. Potential Benefits.

The benefits of this program from 1958 to 1974

(Data from APHIS) are shown below:

Year	Reduction in Losses and Costs	Cost of Program	Savings
1958	\$ 10,000,000	\$ 2,779,000	\$ 7,221,000
1959	20,000,000	5,141,000	14,859,000
1960	20,000,000	2,743,000	17,257,000
1961	20,000,000	1,257,000	18,743,000
1962	32,000,000	3,141,000	28,859,000
1963	52,000,000	5,863,000	46,137,000
1964	77,000,000	6,024,000	70,976,000
1965	94,000,000	5,148,000	88,852,000
1966	99,000,000	4,823,000	94,177,000
1967	119,000,000	5,568,000	113,432,000
1968	127,000,000	5,552,000	121,448,000
1969	135,000,000	7,431,000	127,569,000
1970	142,000,000	6,052,000	135,948,000
1971	147,000,000	7,152,000	139,848,000
1972	109,000,000	8,023,000	100,977,000
1973	164,000,000	11,438,000	152,562,000
1974	<u>195,000,000</u>	<u>12,175,000</u>	<u>182,825,000</u>
	\$1,562,000,000	\$100,310,000	\$1,461,690,000

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1962	32,000,000	3,141,000	28,859,000
1963	52,000,000	2,863,000	49,137,000
1964	77,000,000	6,024,000	70,976,000
1965	94,000,000	2,148,000	91,852,000
1966	99,000,000	4,833,000	94,167,000
1967	119,000,000	2,268,000	116,732,000
1968	127,000,000	2,222,000	124,778,000
1969	135,000,000	7,431,000	127,569,000
1970	142,000,000	6,022,000	135,978,000
1971	147,000,000	7,122,000	140,878,000
1972	109,000,000	8,023,000	100,977,000
1973	164,000,000	11,438,000	152,562,000
1974	192,000,000	12,175,000	179,825,000
	\$1,262,000,000	\$100,210,000	\$1,461,790,000

Dr. Tom Prater (Agricultural Economist, Texas A&M University) and Dr. John Goodwin (Oklahoma State Department of Agriculture) have conducted studies on the cost-benefit ratio of the screwworm program, which are shown below:

	<u>With Program</u>	<u>Without Program</u>
U. S. Population	209,448,200	209,448,200
Per Capita Beef Consumption	114.2 lb	116.0 lb
Retail Beef Prices (Carcass Wt Basis)	87.25¢/lb	81.75¢/lb
Per Capita Expenditure on Beef	\$99.64	\$94.83
Per Capita Savings resulting from the Program		\$4.81
Change in Per Capita Beef Consumption Resulting from the Program		+1.8 lb
Total Retain Expenditures on Beef	\$20,869,418,648	\$19,861,972,806
Total Consumer Savings Resulting from the Screwworm Eradication Program		\$1,007,445,842
Maximum Annual Treasury cost of the Program (Fiscal 1973)		\$8,899,605
Cost-Benefits Ratio		1:113

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Without Program	With Program	
209,448,200	209,448,200	U. S. Population
116.0 lb	114.2 lb	Per Capita Beef Consumption
\$1.75¢/lb	\$7.25¢/lb	Retail Beef Prices (Carcase Wt Basis)
\$94.83	\$99.64	Per Capita Expenditure on Beef
\$4.81		Per Capita Savings resulting from the Program
+1.8 lb		Change in Per Capita Beef Consumption Resulting from the Program
\$19,881,872,806	\$20,669,418,848	Total Retail Expenditures on Beef
\$1,007,445,842		Total Consumer Savings Resulting from the Screwworm Eradication Program
\$8,899,602		Maximum Annual Treasury cost of the Program (Fiscal 1973)
1:113		Cost-Benefit Ratio

These data show 1.8 more pounds of beef per person were available annually to the nation as the result of the program. In addition, they show a per capita savings of \$4.81 and a cost-benefit ratio of 1:113. A later study by Dr. Edward Uvacek, Jr., Livestock Marketing Specialist at Texas A&M University, showed the cost-benefit ratio 1:39. His study indicated that the demand for beef is becoming more elastic, yielding a closer relationship between consumption change and price change.

It is obvious that the eradication program is of considerable worth to the producer and the consumer. As a result of the program, the producer can raise beef and other livestock more cheaply and reliably, which ultimately should be reflected in the price of the product to the consumer. From another point of view, if the program were discontinued or became ineffective, the presence of screwworms would cause a substantial cost to producers who would have to resort to using more insecticides (treating wounds), constructing fences, hiring labor, etc. These costs could cause many producers to go broke or leave the ranching business because of the limited or non-existent profit in the sales of livestock at this time.

It is much more difficult to assess the impact of ARS research on the efficiency and effectiveness of the program. Although all research may ultimately provide a basis for improved technology in the program, of special note are the following accomplishments:

These data show 1.8 more pounds of beef per person were available annually to the nation as the result of the program. In addition, they show a per capita savings of \$4.81 and a cost-benefit ratio of 1:11.3. A later study by Dr. Edward Uvacek, Jr., Livestock Marketing Specialist at Texas A&M University, showed the cost-benefit ratio 1:35. His study indicated that the demand for beef is becoming more elastic, yielding a closer relationship between consumption change and price change.

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It is much more difficult to assess the impact of ARS research on the efficiency and effectiveness of the program. Although all research may ultimately provide a basis for improved technology in the program, of special note are the following accomplishments:

(1) the development of a diet for mass rearing screwworms that consisted of gross foodstuffs such as dried whole blood, calf suckle, cottage cheese, and other ingredients that could be substituted for the standard meat diet; (2) the development of a chemical mixture that attracted screwworm flies which was more specific and more consistent in catches than the standard liver-baited traps; (3) establishing of specific strains of Mexican screwworm flies to replace the older, laboratory-reared strains that originated in Florida. All of these research discoveries (and many others) have been utilized by the APHIS program. The most important impact of the program has been on the minds of scientists. It was the first and only demonstration within the memory of most contemporary scientists that an insect population can be totally eliminated from a vast geographic area and also that an insect population can be managed at very low levels over a vast area by the uniform application of suppressive measures. The program demonstrated that methods can be devised to deal with major pests which are absolutely species specific and which do not kill many beneficial organisms and disrupt the ecology of agricultural regions. This program has led to increased appropriations for research to find new acceptable ways for dealing with pests. In addition, this program demonstrates that the maintenance of a 1400-mile border plus the eradication from Mexico is possible. This program defies the imagination of most pest management people.

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The program of research and development was the following:

F. Research Effort

Currently 7 SY's are at Mission with a budget of \$435,200. The APHIS budget for Mexico and the United States exceeds 20 million. Based on current problems and the expanded program, ARS will not be able to adequately meet the research needs of the APHIS program. Three additional SY's are needed at Mission to support the expanded Mexico program (\$173,000). Their work will include studies on insect competitiveness, trapping, attraction, ecology, and developing release tactics. These personnel should not be placed at Tuxtla Gutierrez until the Mission facility is closed to gain maximum advantage from research dollars. Reasons for this conclusion are:

(1) For monetary reasons: The operational costs for scientists in Mexico are greater than in the United States. Dr. Meyer, Director of the APHIS program, says it costs him around \$40,000 to get each person to Mexico (6 months' Spanish training, per diem, moving expenses). After arrival, housing allowance, schooling costs, and home leave effectively elevate the annual cost about \$15,000/person.

(2) Nature of the research: Most of the needed research in Mexico is ecological, and travel will be necessary regardless of the base location. The area needing maximum effort is around Poza Rica, about 500 miles from Mission and 600 miles from Tuxtla Gutierrez. We have recently purchased a 24-foot camper because of

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(1) For monetary reasons: The operational costs for scientists in Mexico are greater than in the United States. Dr. Meyer, Director of the APHS program, says it costs him around \$40,000 to get each person to Mexico (6 months' Spanish training, per diem, moving expenses). After arrival, housing allowance, schooling costs, and home leave effectively elevate the annual cost about \$12,000 per person.

(2) Nature of the research: Most of the needed research in Mexico is ecological, and travel will be necessary regardless of the base location. The area needing maximum effort is around Pozo Rico, about 200 miles from Mission and 600 miles from Tuxtepec. We have recently purchased a 24-foot camper because of

the need for research in isolated areas of Mexico. In addition, more commercial travel routes are available in the Mission area than from Tuxtla Gutierrez.

(3) Logistics: Much of the equipment we use in research is specialized and repairs and service will be expensive or impossible to obtain in Tuxtla Gutierrez. Also, communication with the scientific community will be difficult. Currently, we have research relationships with Texas A&M, The University of Texas, Metabolism Laboratory at Fargo, Attractants Laboratory at Gainesville, and NASA. Their input will be easier to coordinate from our Mission location. In addition, qualified support personnel are difficult to hire in Tuxtla Gutierrez.

(4) Type of Work at Tuxtla Gutierrez: Most of the problems at the factory will be operational and directly involved with production. Distribution and handling problems will be equally great at the distribution centers. The Methods Development Sections from Tuxtla Gutierrez and Mission can best handle these problems.

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problems.

Information assembled by Roy Drummond

this is a good starting place for work up

III.1. New and Improved Methods to Reduce Losses Caused by Insects,

Ticks and Mites.

A. Current Technology

1. Important Species

Haematobia irritans L., horn fly

Musca autumnalis, face fly

Hypoderma lineatum, common cattle grub

Hypoderma bovis, northern cattle grub

Stomoxys calcitrans, stable fly

Tabanidae, -horse flies and deer flies (several species)

Culicidae - mosquitoes (several species)

Ceratopogonidae and Simuliidae - gnats, punkies, blackflies, etc.

Cochliomyia hominivorax, screwworm

Calliphoridae and Sarcophagidae - blowflies and flesh flies (several species)

Amblyomma americanum, lone star tick

Amblyomma maculatum, Gulf Coast tick

Dermacentor albipictus, winter tick

Dermacentor andersoni, Rocky Mountain wood tick

Dermacentor occidentalis, Pacific Coast tick

Dermacentor variabilis, American dog tick

Ixodes scapularis, black-legged tick

Otobius megnini, Spinose ear tick

Psoroptes bovis, common scab mite

Chorioptes bovis, Psoroptic scab mite

Sarcoptes bovis, itch mite

Demodex bovis, cattle follicle mite

Linognathus vituli, long nosed sucking louse

Haematopinus eurysternus, shortnosed sucking louse

Haematopinus quadripertusis, cattle tail louse

Bovicola bovis, cattle biting louse

2. Costs of arthropod-caused damage.

<u>Arthropod group</u>	<u>Type of Damage</u>	<u>Losses</u> ((\$1000)
Cattle grubs	Hide loss	192,000
	Reduced milk flow	
	Meat trim	
	Gadding	
Biting flies	Irritation	218,000
	Decreased grazing & milk flow	
	Anaplasmosis transmission	
	Blood loss	
Face flies	Irritation	68,000
	Eye problems	
	Decreased grazing	
	Pink eye transmission	

<u>Arthropod group</u>	<u>Type of Damage</u>	<u>Losses</u> <u>(\$1000)</u>
Ticks	Blood loss	60,000
	Tick worry	
	Irritation	
	Disease transmission	
	Paralysis	
Lice	Irritation	47,000
	Decreased production	
	Blood loss	
Mites (mange & scab)	Irritation	3,000
	Dermatitis	
	Quarantine (State & Federal)	
Screwworms and Blowflies	Death loss	*
	Decreased production	
		588,000

a/from "Losses in Agriculture" AH-291

* losses minimized due to eradication program

3. Present solutions

<u>Arthropod</u>	<u>Solution</u>
Cattle grubs	Treated cattle annually with animal systemic insecticides (orally or dermally) before grubs appear in backs.
Biting flies	Horn flies - treat cattle topically with insecticides by spray, pouron, back rubbers, dust bags, etc., to kill adult flies; treat cattle orally (feed, mineral or salt block) with insecticides or IGR's to control larvae in manure. Stable flies - sanitation to remove larval inhabiting sites; apply repellents or toxicants (usually daily) to repel or kill adults.

Others - (horseflies, mosquitoes, gnats, buffalo flies, etc.) - remove or treat larval inhabiting sites. Apply repellents or toxicants to cattle (very short lived).

Faceflies

Have self-treatment devices (dust bags, face and back rubbers) available for continuous treatment of eyes and face area with insecticides. (Treatments generally ineffective).

Ticks

Treat attachment sites (ears, body, etc.) on cattle with insecticides (dip, spray, dust, smear, etc.) to kill attached ticks and prevent reinfestation. May be necessary to treat several times. Remove cattle from infested pastures. Certain species are under state and Federal quarantine.

Lice

Treat infestation sites (usually entire animal) dermally with insecticides (dip, spray, pour-on, dust, etc.) to kill lice and eggs or to kill newly-hatched nymphs.

Mange & scab mites

Some species are under Federal quarantine. Dip or spray animals thoroughly several times to eliminate infestation.

Screwworms and

blowflies

Screwworms are subjects of an eradication program utilizing wound treatment and release of sterile males. Treat and retreat wounds with insecticides to kill infestation and prevent reinfestation.

4. Technological advancements in the last 10 years.

a. Use of animal systemic insecticide to kill cattle grubs before they arrive in the animals' backs and cause losses in cattle.

(Pouyon treatment).

b. Place self-treatment dust bags in pastures so cattle can treat themselves for control of hornflies (limited control of faceflies).

c. Incorporation of insecticides and IGR (methoprene) in feed, salt or mineral block to control horn fly larvae in manure.

5. Major research accomplishments in last 10 years. (Not part of technology)

a. Automatic equipment to disperse low volumes or ultra-low volumes of insecticides for the control of biting flies.

B. Visualized Technology

1. Chemical control.

a. Injectable animal systemic insecticides for the control of cattle grubs and blood sucking arthropods.

b. Salt or mineral blocks or protein feed supplement that

contain insecticides and other chemicals that will afford control of insects, ticks and mites affecting cattle.

c. Implants and other slow-release devices that would dissolve slowly, liberating minute amounts of insecticides into the system of the cattle where the insecticides would be toxic to arthropod feeding on or in cattle.

d. Alterations in formulations, solvents, etc., that would allow a dermally-applied insecticide to penetrate or attach to the hair coat and remain insecticidally active for longer periods.

e. Development and use of insecticides that would be non-toxic to cattle and not leave residues in meat and milk.

2. Other control technology

a. Sterile male technique (horn fly, stable fly).

b. Dung beetles for control of larvae of the horn fly in manure.

c. Use of pheromones, etc. to trap, confine, arthropods.

3. Pest management systems

a. IGR's and release of sterile males for control or eradication of horn flies (Pilot Test).

4. Resistant cattle

a. Breed cattle that are innately resistant to insects, ticks and mites.

b. Use immunological techniques to create resistance in cattle.

C. Research Approaches

1. Develop new information on the biology of insect, tick, and mite parasites of cattle. Obtain data on ecology, field biology, seasonal incidence, laboratory colonization, host-parasite relationships, physiology of parasites (how do they live; where do they live). Special needs are for basic information on tabanids, mange and scab mites, ticks and face flies. An important facet is the need for information on the effects of insects, ticks and mites on the hosts.

2. Develop new information on chemical control of insect, tick and mite parasites of cattle. Find new compounds and/or new molecules of activity, develop new formulations to provide longer residual effects of present insecticides and simpler techniques of self-application. Treat the environment to control parasites without causing harmful effects. Find insecticides that are safer to livestock and will not create residues in tissues.

3. Develop nonchemical technology for use in control of insect, tick and mite parasites of cattle. Find and utilize parasites, pathogens (e.g. Bacillus thuringensis for control of Diptera), and predators (dung beetles). Develop radiation sterilization research and test the sterile male technique. Determine if genetic incompatibility, F_1 sterility, hybrid sterility, and cytoplasmic sterility can be used. Use sound, light, and other physical phenomena to disrupt life cycle. Isolate and define attraction mechanisms - pheromones, attractants, etc. Develop trapping technology for use as a survey tool.

4. Develop cattle resistant to insect, tick and mite parasites of cattle. Survey cattle breeds and within breeds to find cattle naturally resistant to arthropods. Determine thru selective breeding if this resistance is inherited and the type of inheritance. Study the host-parasite immunological relationships to determine the mechanisms used by the host and the counter mechanisms of the parasite to maintain the relationship. Develop vaccines to create resistance in susceptible cattle.

D. Consequences of Visualized Technology

1. Resistant cattle

2. New and better insecticides.

3. Season-long insecticidal control of insects, ticks and mites.
4. Decreased use of insecticides.
5. Lessened risk of accidents with toxicants in livestock and humans and decreased hazards from insecticides.
6. No residues of insecticides in meat and milk.
7. Decreased losses from disease.
8. Decreased losses due to eye troubles..

E. Total Potential Benefits

<u>Change (improvement)</u>	<u>Savings or Reduced Cost (\$1000)</u>
Decrease death loss	
Decrease meat trim	
Decrease disease transmission	
Decrease hide loss	
Increased milk flow	
Increased weight gain	
Uninterrupted grazing	
Decrease handling of cattle (labor)	

F. Total Research Effort

HORSES

III.2. New and Improved Methods to Reduce Losses Caused by Insects, Ticks and Mites.

A. Current Technology

1. Important species:

Gastrophilus haemorrhodalis, nose bot fly

Gastrophilus intestinalis, horse bot fly

Gastrophilus nasalis, throat bot fly

Anocentor nitens, tropical horse tick

Dermacentor albipictus, winter tick

Dermacentor occidentalis, Pacific Coast tick

Dermacentor variabilis, American dog tick

Ixodes scapularis, blacklegged tick

Otobius megnini, spinose ear tick

Haematopinus asini, horse sucking louse

Bovicola equi, horse biting louse

Chorioptes bovis, chorioptic scab mite

Psoroptes equi, common scab mite

Sarcoptes scabiei, sarcoptic scab mite

Trombiculidae -several spp. of chiggers

Stomoxys calcitrans, stable fly

Musca autumnalis, face fly

Musca domestica, housefly

Tabanidae -- numerous spp of horse and deer flies

Cochliomyia hominivorax, screwworm fly

Calliphoridae and Sarcophagidae, blow flies and flesh flies

Simuliidae and Ceratopogonidae,-- gnats, punkies, etc.

Culicidae,-- several species of mosquitoes

2. Arthropod-caused damage and costs.

Arthropod	Damage	\$ Loss ^{a/} (1000)
Horse bots	Colic Stomach damage Mouth irritation	3,250
Facefly & housefly	Eye irritation & diseases <u>Habronema</u> transmission Annoyance	2,000
Biting flies	Blood loss Irritation <u>Habronema</u> transmission Anaplasmosis transmission Annoyance	2,000
Gnats & mosquitoes	Annoyance Transmission of WEE, EEE & VEE Skin reactions Loss of hair	1,750
Mange & scab mites	Inflammation Hair loss Skin damage Itching	?

Chiggers	Dermatitis Skin lesions Irritation	?
Lice	Irritation Loss of hair Unthriftiness	500
Ticks	Blood loss Transmit equine pyroplasmosis Weakness Emaciation	1,500

a/ From "Losses in Agriculture", AH-291 11,000

3. Present solution.

a. Horse bots: Allow horses to treat themselves orally with trichlorfon (a systemic insecticide) in feed for 1 day at 40 mg/kg to kill all of the bots in the horse. Also, carbon beulfide boluses available to kill bots in stomach.

b. Facefly and housefly: Treat face with insecticides. Treatments work poorly because of lack of residual activity against flies that feed only on moist areas; leather masks attached to halters afford some protection.

c. Biting flies (stable flies, horseflies, deer flies, etc.): Sanitation to remove breeding sites of stable flies; short term (1-2 days) control available by applying insecticides to horses as sprays, wipes, sponges, etc. Daily application of repellents affords some protection against biting flies. All treatments are of very short residual effectiveness.

d. Gnats and mosquitoes: Destroy breeding sites of mosquitoes (if possible); in outbreaks of VEE, malathion sprays were applied to large land areas to control mosquitoes; toxicants and repellents applied to horses are of little help because of short duration of effectiveness.

e. Mange and scab mites: Control by thoroughly treating horses with approved insecticides. Multiple treatments are necessary to achieve eradication of the mites and prevent the irritation.

f. Chiggers. Usually controlled by treating infested areas of the horse with insecticides. One treatment controls the mites.

g. Lice: Infestations are controlled by treating the horses thoroughly with insecticides as sprays, washes, brush-on or sponge-on. Usually 2 treatments are necessary to kill the lice and eliminate infestation.

h. Ticks: Treatment depends upon the species of ticks to be controlled. Tropical horse ticks are controlled by treating ears and nasal diverticulae as well as the whole body with insecticides. Spinose ear ticks are controlled by treating ears with ointments, dusts, smears, etc. Ticks on the body are controlled by treating horses with approved insecticides as sprays, sponge-on or wash.

4. Technological advances in the last 10 years.

- a. Use of trichlorfon as an animal systemic insecticide in feed of horses is a widely accepted practice to control horse bots in horses.
- b. There have been no changes in technology to control the other insects, ticks and mites of horses.

5. Major research accomplishments in the past 10 years: None.

B. Visualized Technology

1. Chemical control.

Long lasting (several weeks or longer) treatments (applied by hand or self treatment) to kill or repel biting flies, faceflies, gnats, mosquitoes, etc. Use of a systemic insecticide in feed or water to control or repel insects, ticks and mites of horses.

2. Other control technology.

Use of parasites, pathogens and predators to control the parasites, especially the biting flies that attack horses. Use of attractants to trap flies; pheromones to disrupt mating activities.

3. Pest management systems.

Have available a variety of techniques, including insecticide treatments, specialized housing, simple treatment techniques, release of

4. Resistant horses.

A selected breed of horses that would be resistant to ectoparasites. An injection or other treatment that could create or enhance the immune response in horses to make them agents of control for their ectoparasites.

C. Research Approaches

1. Basic biology.

Obtain preliminary or additional data on the life history, ecology, seasonal appearance, host-parasite relationships of insect, tick and mite parasites of horses. An important aspect is the need to obtain information on the effects of insects, ticks and mites on horses.

2. Control techniques.

Continue to screen newly-synthesized materials as toxicants and repellants for biting flies, animal systemic insectants, and acaricides for control of ticks and mites. Secondly, test the most effective of these insecticides on horses to determine effects against horse ectoparasites. Devise and evaluate new formulations of insecticides and new methods of application of insecticides especially designed for use on horses.

3. Non-chemical control techniques.

parasites and pathogens and conduct research to enhance these natural control agents. Utilize input from engineers in order to design manure disposal equipment and farm and stable structures so as to reduce population of ectoparasites, especially biting flies on horses. Investigate mechanisms and materials to disrupt or prevent host finding, mating activities, etc., of insect, tick and mite parasites of horses.

4. Resistant horses.

Make critical observations on the differential infestation of horses with insects, ticks and mites. Make selective crosses of these resistant horses to determine if subsequent generations are also resistant to the parasites. In addition, determine the host-parasite relationships especially the immune response and determine if that response can be enhanced through injections of antigens, antibodies, etc. Utilize these techniques to develop resistant hosts.

D. Consequences of Visualized Technology

1. Decreased incidence of VEE, WEE and EEE.
2. Decreased use of pesticides.
3. Decreased transmission of equine pyroplasmosis.
4. Decreased transmission of Habronema.

5. Lessened annoyance and irritation to horses from insects.

6. Elimination of mange and scab mites, and their irritation and itching, from horses.

7. More pleasurable riding experiences.

8. Increased esthetic appearance of pleasure horses.

E. Total Potential Benefits

<u>Improvement</u>	<u>Benefit</u> <u>(\$1000)</u>
Decrease disease	6,000
Decrease pesticide use	2,000
Decreased annoyance and irritation	
Increased riding pleasure	

F. Total Research Effort

SHEEP AND GOATS

III.3. New and Improved Methods to Reduce Losses Caused by Insects, Ticks and Mites

A. Current Technology

1. Important species

Bovicola ovis, sheep biting louse

Linognathus ovillus, sucking body louse

Linognathus pedalis, sucking foot louse

Bovicola crassipes

Bovicola limbatus, Angora goat biting louse

Bovicola caprae, goat biting louse

Linognathus stenopsis, goat sucking louse

Linognathus africanus

Chorioptes bovis, sheep scab mite

Psorergates ovis

Chorioptes caprae, goat scab mite

Demodex ovis, sheep mange mite

Demodex caprae, goat mange mite

Cochliomyia hominivorax, screwworm

Cochliomyia macellaria, secondary screwworm

Phormia regina, black blow fly

Phaenicia sericata

Melophagus ovinus, sheep ked

Estrus ovis, sheep nose bot fly

Otobius megnini, spinole ear tick

Ceratopogonidae and Simuliidae - gnats, blackflies, punkies (several spp)

2. Cost of arthropod-caused damage.

Arthropod	Damage	Cost ^{a/} (\$1000)
Lice	Irritation	4,700
	Itching	
	Reduction in wool and mohair	
Keds	Causes cockle re	9,400
	Reduction in market value of leather	
	Decreased carcass weight	
	Lessened wool growth	
Scab & mange mites	Irritation	2,000
	Itching	
	Decrease in quantity & quality of wool or mohair	
	General unthriftiness	
	Quarantinable disease	
Biting flies	Blood loss	?
	Transmission of bluetongue	
Screwworms & fleeceworms	Death of animal	*
	Loss of wool & mohair	
	Extreme debilitation	
Sheep nose bots	Irritation to nasal passage	8,000
	Loss of condition	
		24,100

^{a/}from "Losses in Agriculture", AH-291

* Eradication program for screwworm

3. Present solutions .

The most common methods used to control keds and lice are to thoroughly treat the sheep with insecticides applied as sprays, dips, or dusts to kill existing infestations and have residual effectiveness to prevent reinfestation. It may be necessary to treat the animals 2 or 3 times in order to adequately control the infestations.

Scab and mange mites are controlled through dipping and whole-body sprays. It is extremely important that the treatments be very thorough to insure that all of the lesions on the animals are treated with insecticide. Sheep may be held under quarantine if found infested with Psoroptes ovis. In that instance, animals have to be treated according to APHIS regimen.

Screwworms and fleeceworms, Because of the Screwworm Eradication Program, utilizing treatment of wounds and the release of sterile males, infestations of sheep with screwworms are seldom encountered, although fleeceworm infestations are seen. Wounds or infested areas should be thoroughly treated with insecticide smears, ointments or dusts, and samples of larvae sent to proper authorities for identification.

Sheep nose bot. At the present time there is no treatment available for the control of the larvae of sheep nose bot fly in the mucous

surfaces of the nasal passages and sinuses of sheep and goats. A number of systemic insecticides effectively kill these larvae when administered to sheep orally as sprays, pourons, in the feed, or as intramuscular injections. Unfortunately, none of these treatments is presently available for rancher use. In addition, certain insecticides may be applied to the external and internal surfaces of the nostrils in order to kill larvae.

4. Technological advancements in the last 10 years .

Although several new insecticides have been added to the list suggested for use on sheep, there have been no major advances in technology for the control of sheep or goat lice, sheep keds, mange and scab mites, and screwworms and fleeceworms on sheep.

The Screwworm Eradication Program has allowed ranchers to be able to shear sheep and goats and not treat them with insecticides, as was their custom when screwworms were present in the Southwestern United States.

The programs to eradicate mange from sheep have been severely handicapped due to the fact that lindane is no longer approved as a livestock dip or spray.

5. Research accomplishments in the past 10 years (not part of technology)

The development of animal systemic insecticides that are systemically

active against sheep nose bots in the nasal passage of sheep has been a major research advancement, but because of development costs or user costs, no animal systemic insecticide is marketed at the present time for the control of this parasite.

B. Visualized Technology

1. Chemical control.

There needs to be a series of new insecticides that can be used as a single treatment for the eradication of mange and scab mites from sheep and goats. The costs of handling the animals and maintaining them under quarantine are prohibitive. If an insecticide, applied as a spray or dip, or even as an oral treatment in feed, would control these quarantineable arthropods, this type of treatment would lead to an eradication of these arthropods from the United States.

2. Other control technology.

Because of the fact that it may be difficult to find new insecticides that are effective, safe to use, and do not form harmful residues in tissues, research should be conducted to find other methods of controlling these arthropods on sheep. The possibility of finding parasites and pathogens and predators of lice, mites and keds should be investigated.

3. Sheep management systems.

Because of the nature in which sheep and goats are managed in terms of yearly or bi-yearly shearing, the possibility exists, and should be investigated, that specific management systems involving the use of insecticides, animal husbandry and other factors could be developed that would prevent the buildup of populations of lice, keds and other parasites so thoroughly as to eliminate monetary losses due to these parasites.

4. Resistant sheep.

Develop a breed of sheep that is resistant to insects, ticks and mites. Use immunological techniques to create resistance in susceptible animals. In addition, the immune-response relationship between the sheep and its ectoparasites should be investigated to determine if immune-response can be enhanced so as to use animals to destroy these ectoparasites.

C. Research Approaches

1. Basic biology.

Obtain detailed information on the life history, ecology and seasonal appearance of sheep ectoparasites. Of special importance is the need for information on the effects of insects, ticks and mites on sheep and goats.

2. Control techniques.

Test newly screened systemic insecticides in sheep to find easily administered, inexpensive treatments for the control of sheep nose bot larvae. Test newly-discovered insecticides and other chemical control agents on insects, ticks and mites of sheep. Develop new formulations and treatment apparatus for use on sheep.

3. Non-chemical control techniques.

Determine if sheep ectoparasites are subjects of parasites, pathogens and predators. Investigate physical control techniques and other mechanical means of control.

4. Resistant hosts. De

Determine if individual sheep or breeds of sheep are naturally resistant to insects, ticks and mites. Determine if these cases of natural resistance can be amplified and genetically controlled through breeding experiments. Conduct studies to determine the nature of resistance and if this resistance can be developed in susceptible animals through immunization techniques.

D. Consequences of Visualized Technology

1. More wool and mohair

2. Healthier sheep and goats

3. Less death loss

4. Decreased transmission of bluetongue

5. Increased milk production of dairy goats

6. Lessened use of insecticides

7. Decreased need to gather animals

E. Total Potential Benefits

<u>Improvement</u>	<u>Benefit</u> (\$1000)
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Decreased disease

Less pesticide use

Increased production

F. Total Research Effort

SWINE

III.4. New and Improved Methods to Reduce Losses Caused by Insects,

Ticks and Mites.

A. Current Technology

1. Important species.

Haematopinus suis, the hog louse

Sarcoptes scabiei suis, scab mite

Demodex sp, mange mite

2. Cost of arthropod-caused damage.

<u>Arthropods</u>	<u>Damage</u>	<u>Losses^{a/}</u> <u>(\$1000)</u>
Lice and mites	Irritation	3,000
	Itching	
	Decreased weight gains	
	Blood loss	
	Stunted growth	

^{a/}From "Agricultural Handbook", AH-291

3. Present solutions.

Present solutions to control lice and mites on swine is to treat the animals with insecticides applied as whole body sprays, dips, dusts, pouron, by back rubbers or oilers and treatment of the premises (bedding, litter, wallows and other areas) with insecticides.

4. Technological advances in the last 10 years.

No changes in treatment techniques, although some new insecticides have been added to the list of insecticides approved for application to swine.

5. Major research accomplishments in the last 10 years: none.

B. Visualized technology

1. Chemical control.

New chemicals may afford longer residual effectiveness and therefore one treatment would provide long lasting control to the arthropods thus eliminating the necessity of re-treatment. Possibly insecticides could be added to the diet of the animals and be systemically active against the insects, ticks and mites.

2. Other control techniques.

If discovered, parasites, pathogens and predators could be released in hog lots to control the mites and lice.

3. Pest management systems.

A possibility of utilizing insecticides, special structures, and other techniques may be combined, but appear to be limited because the parasites spend their entire life cycles on the hosts.

4. Resistant swine.

Populations of lice and mites vary on different animals. The possibility that certain animals have innate resistance to these parasites could be investigated and utilized as a control technique. The creation of resistant swine through immunological techniques is a possibility.

C. Research Approaches

1. Studies on the transmission of mange and the life history of the mange and scab mites should be undertaken in order to determine more about their biological cycle in swine. Other basic studies on the biology of both mange mites and lice should be undertaken. Especially important are studies to determine the effects of insects and mites on swine.

2. As new insecticides are found in screening tests, the most promising of these should be applied to swine to determine effectiveness for the control of lice and mange. A limited number of animal systemic insecticides should be given orally, dermally, or injected into swine to determine their effects against swine ectoparasites.

3. The total environment of swine with relation to ectoparasites should be studied in order to determine if such factors as building construction, manure disposal, housing facilities, etc., could be utilized in the

control of insects and mites. In addition, these parasites should be investigated in order to determine if they are attacked by parasites, pathogens and predators. If any are found, they should be then colonized or cultured in order to be released in large enough numbers to effect a control.

4. Swine should be studied to determine relative infestation rates of these arthropods to determine if an innate resistance exists in swine. If such a resistance is found, it should be further studied to determine if it can be enhanced by selection. In addition, acquired immunity should be investigated to determine if the host parasite interface could be disrupted through the use of immunological techniques.

D. Consequence of Visualized Techniques

1. Decrease of use of insecticides.
2. Increased growth rate.
3. Reduction of mange mites and lice.
4. Breeds of arthropod resistant animals available.

E. Total Potential Benefits

<u>Change</u>	<u>Benefit</u> (\$1000)
Decreased death loss	
Increased weight gains	
Decreased use of insecticide	

F. Total Research Effort

POULTRY

III.5. New and Improved Methods to Reduce Losses Caused by Insects, Ticks and Mites

A. Current Technology

1. Important species:

Dermanyssus gallinae, the poultry mite

^{fr.}
Ornithonyssus sylvarium, northern fowl mite

Ornithonyssus bursa, tropical fowl mite

Argas spp, fowl ticks

Menacanthus stramineus, body louse

Menopon gallinae, shaft louse

Lipeurus heterographus, head louse

Lipeurus caponis, wing louse

Goniocotes hologaster, fluff louse

Neoschongastia americana, turkey chigger

(a few other minor pests)

2. Costs of arthropod caused damage.

Arthropod	Damage	Costs ^{a/} (\$1000)
Poultry lice & mites	Loss of weight	75,000
	Reduced egg production	
	Weakened condition	
	Blood loss	
	Lowered vitality	
Fowl ticks	Blood loss	750
	Paralysis	
	Weakened condition	
	Decreased egg production	
Chiggers	Trim loss at slaughter	25,900
		101,650

^{a/}From "Losses in Agriculture", AH-291.

3. Present solutions.

Present technology used to control fowl mites and lice and other ectoparasites that spend their life cycle on poultry are to treat the birds with insecticide applied as a dip, whole-body spray, mist spray, dust, floor or litter treatment, dust box treatment. Treatments may need to be applied several times in order to reduce or eliminate the populations of these arthropods. Techniques used to control poultry red mites and fowl ticks which feed intermittently on hosts and spend the remainder of time in cracks and crevices of the poultry house are to treat walls, poultry house structures, roosts, cracks and other surfaces with insecticide to kill these arthropods in their hiding places. Treatments need to be repeated at intervals in order to be assured of control of the arthropods. Chiggers on

2. Costs of antituberculous therapy.

Antituberculous	Drugs	Costs (1950)
Penicillin 2 million units of activity	100,000	10,000
Streptomycin 100 mg	100,000	10,000
Para-aminosalicylic acid 100 mg	100,000	10,000
Isoniazid 100 mg	100,000	10,000
Other drugs	100,000	10,000
Total costs	500,000	50,000
Other costs	100,000	10,000
Total costs of antituberculous therapy	600,000	60,000

2. "Antituberculous therapy," 1950-1951.

3. Treatment of tuberculosis.

Antituberculous therapy is a long-term process and requires a high degree of discipline and organization.

Other organizations that spend their time on tuberculosis are the American Lung Association, the National Tuberculosis Association, and the World Health Organization.

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turkeys are controlled by spraying the ground with large volumes of insecticides.

4. Technological advancements in the last 10 years.

The change in dermal application of insecticides to poultry has been from large volume individual bird handling treatments to rapidly applied mist sprays to large groups of birds especially those in caged layer poultry houses. Actually, very small amounts of insecticide are applied to individual birds. More recently, a product has been approved for application to the soil for the control of turkey chiggers.

4. Technological advancements in the last 10 years.

A few new insecticides have been added to the list of materials that are approved for use on poultry. The research to utilize insecticides for the control of turkey chiggers has finally come to fruition in the granting of a label for the application to ground areas.

5. Major research accomplishments in the last 10 years.

The use of strips containing vaporizable insecticides has shown promise for the control of mites and lice that live on poultry. However, none of these treatments or techniques have been utilized.

B. Visualized Technology

1. Chemical control.

It is invisioned that insecticides and new treatment technology could be utilized that would, in one treatment, control the lice and mites that live on birds and also control those that hide in cracks and crevices in the poultry house. A single treatment would kill motile forms and also kill eggs. A possibility of insecticide incorporated into the feed or water of poultry appears to be a promising technique.

2. Other control technology.

The possibility that other technology such as biological control agents including parasites, predators and pathogens should be available and included in a total program of arthropod pest control.

3. Pest management systems.

Possibly a combination of chemical control, with all biological control agents, development of poultry house structures, and other programs could be integrated into a total management system for the control of the arthropods that live on poultry. Certainly management of turkeys on specific ground areas could be utilized to control the turkey chigger.

4. Resistant poultry.

Obviously different breeds and poultry within breeds exhibit differential susceptibility to infestation of insects, ticks and mites. A possibility that strains of these birds could be developed that are naturally resistant to arthropods should be investigated. In addition, the possibility exists that a vaccination could be developed that would render the birds immune to the bites and blood sucking activity of these ectoparasites.

C. Research Approach

1. Develop new information on the basic biology of arthropod parasites of poultry and the effects that populations of these parasites have on the egg production, thriftiness and general well-being of the birds. Also, determine the intimate host-parasite relationships between the birds and their lice, tick and mite parasites. Obtain data on the effect of insects, ticks and mites on poultry.
2. Continue to utilize screening tests to find new and more effective insecticides for the control of insect, tick and mite parasites of poultry. Evaluate new formulations, new application techniques such as ultra low volume spraying or treatment by the inclusion of insecticides to feed and water.

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3. Continue to study the effects of parasites, pathogens and predators on the populations of poultry ectoparasites. Determine if radiation sterilization can effectively control fowl ticks. Cooperate closely with other researchers to determine effects for modification of poultry housing to effect control of arthropod pests of poultry.

4. Work closely with genetist and an immunologist to determine inheritance of innate resistance of poultry to specific ectoparasites. Determine the mechanism used by birds to fight their ectoparasites and use this information to create vaccines for the control of mites, ticks and lice parasites of poultry.

D. Consequences of Visualized Technology

1. Resistant poultry
2. New and more effective insecticides
3. Increased egg production
4. Increased weight gains
5. Decreased use of insecticides
6. No residues of insecticides in poultry meat and eggs.

E. Total Potential Benefits

<u>Change</u>	<u>Benefit</u> <u>(\$1000)</u>
Increased weight gains	
Increased egg production	
<u>Decreased insecticide use</u>	

F. Total Research Effort

PETS, WILDLIFE AND OTHER ANIMALS

III.6. New and Improved Methods to Reduce Losses Caused by Insects,

Ticks and Mites

A. Current Technology

1. Important species.

a. Pets: Rhipicephalus sanguineus, brown dog tick

Ctenocephalides felis, cat flea

Ctenocephalides canis, dog flea

Otodectes canis, ear mites of dogs

A variety of biting lice found on pet parrots and other house birds.

b. Laboratory animals: Mange mites and other ectoparasites

c. Wildlife: Animals in zoos and wildlife farms as well as

free wildlife have a variety of insect, tick and mite parasites. Usually an

animal species have a specific fauna of insects, ticks and mites; but many

insects, ticks and mites of livestock will also attack wildlife.

d. Other animals: This category could include such domesticated type wildlife as minks, chinchillas, rabbits and other animals that each have their specific fauna of insect, tick and mite parasites.

2. Costs of arthropod caused damage.

There are no accurate figures for the actual monetary losses caused by insect, tick and mite parasites of pets, wildlife and other animals.

3. Present solutions.

To control fleas and ticks on dogs and cats, owners may use dips, sprays, washes or dusts of insecticide. More recently the insecticide-bearing collar has been a popular technological advance used to control these parasites. Laboratory animals may be treated dermally with insecticides to control ectoparasites. Systemic insecticide, ronnel, applied to the litter of mink is effective in controlling the bot flies found in these animals. In general, wildlife are not treated with insecticides for the control of parasites. Zoo animals may be treated. For example, silica dusts have been applied to cages and confinements for snakes to control snake mites.

4. Technicological advancements in the last 10 years.

The appearance of the dog collar appears to be a major technological advancement in the control of insect and tick parasites of dogs and cats.

5. Major research accomplishants in the last 10 years.

Because of the lack of research input into this area there appear

B. Visualized Technology

1. Chemical control.

An insecticide that could be extremely safe and applied in a manner that would not be toxic to pets, wildlife and other animals could be developed through the use of existing techniques with the emphasis placed on the application of these new materials to the specific animals. The possibility of adding insecticides to the diet of these special animals would provide a control of parasites.

2. Other control technology.

The use of special housing for pets, wildlife and other animals could decrease populations of insects, ticks and mites. Many of these same species that attack domestic animals also attack wildlife; for example, Lone Star tick, Estr~~ous~~us ovis and many others. Other control technology used to control these species on livestock should be investigated for their use on pets, wildlife and other animals.

3. Pest management systems.

The cooperative work with Parks and Wildlife individuals could lead to a variety of control technology including pasture rotation or vacation in order to reduce populations of ticks in the field. Other systems of con-

4. Resistant animals.

Opportunities for breeding laboratory animals, pets and wildlife should be utilized to determine if there is a genetic basis for resistance to arthropod pests or if innate resistance can be increased through new innovative immunological techniques.

C. Research Approaches

Research in this area would be extremely limited but could be very beneficial because of the high visibility of the pets, wildlife and other animals. Certainly this research would include close cooperation with personnel of Fish and Wildlife Departments and other organizations dealing specifically with pets, wildlife and other animals. Such research should include, if possible, studies on biology, seasonal appearance and other facets of the ecology of insect, tick and mite parasites of pets, wildlife and other animals, and the effects of parasites on these animals. New control techniques that are applicable to livestock should be tested whenever possible on these other animals. However, great caution should be exercised in terms of toxicity of materials and on the basis of temperament of animals undergoing treatment. This research should also include some investigations as to the mechanism of resistance and the possibility of

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utilizing this resistance for the control of insect, tick and mite parasites.

D. Consequences of Visualized Technology

1. Household pets will have fewer or no parasites.
2. Laboratory animals can be raised without the effects of parasites confounding experimental results.
3. Losses in wildlife would be reduced.
4. The possibility of transmission of disease from wildlife to domestic animals through arthropods would be reduced.
5. There would be more wildlife available for conservationists as well as hunters.
6. There would be an increase in production of mink and chinchilla.

E. Total Potential Benefits

